

AGRICULTURAL
ECONOMICS
RESEARCH UNIT



Lincoln College

AN ANALYSIS OF THE
RETAIL DEMAND FOR MEAT
IN THE UNITED KINGDOM

by

B. P. PHILPOTT and M. J. MATHESON

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AN ANALYSIS OF THE RETAIL DEMAND FOR
MEAT IN THE UNITED KINGDOM

B. P. PHILPOTT

Professor of Agricultural Economics
and

MARY J. MATHESON

Research Assistant
Agricultural Economics Research Unit

Lincoln College
(University of Canterbury)

THE AGRICULTURAL ECONOMICS RESEARCH UNIT

THE Unit was established in 1962 at Lincoln College with an annual grant from the Department of Scientific and Industrial Research. This general grant has been supplemented by grants from the Wool Research Organisation, the Nuffield Foundation and the New Zealand Forest Service for specific research projects.

The Unit has on hand a long-term programme of research in the fields of agricultural marketing and agricultural production, resource economics, and the relationship between agriculture and the general economy. The results of these research studies will be published as Unit reports from time to time as projects are completed. In addition, it is intended to produce other bulletins which may range from discussion papers outlining proposed studies to reprints of papers published or delivered elsewhere. All publications will be available to the public on request. For list of publications see inside back cover.

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P R E F A C E

The value of New Zealand's meat exports is close to £100 million per annum. Any business organisation selling a product on such a scale would ensure that it possessed very full up-to-date details as to the main factors affecting the sales of its product. However, New Zealand meat is not sold through one large business organisation but through a variety of local and overseas firms and this variety of selling channels perhaps accounts for our state of almost complete ignorance as to the quantitative significance of the various factors affecting the consumption of our meat in the main markets to which we send it.

The Research Unit's programme of market research aims to provide some of this information and the present bulletin is the result of the first stage in our programme of work in this field.

Much of the data used in the analyses which follow came from the British National Food Survey Committee whose assistance in providing supplementary information, where required, we gratefully acknowledge.

Lincoln College,
November 1965

B. P. Philpott

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I. INTRODUCTION

In this paper we present the results of some research on the factors affecting the consumption of various types of meat in the United Kingdom, since the introduction of rationing in late 1954.

At this initial stage in the publication of our results, we have concentrated our attention on the retail consumption of various types of meat - lamb, beef, pork, poultry and non carcass meat - regardless of country of origin, largely because data are available on retail consumption and retail prices for these broad types of meat, whereas no retail data exist for different meats from different countries nor, for that matter, for fresh, compared with frozen, or chilled meat.¹

Our specific aim in the analysis which follows is to estimate, as far as it is possible to do so, the following parameters:

¹ A further stage of this research project specifically aimed at demand measurement for New Zealand meat, and using adjusted wholesale data, has now been commenced in the Research Unit.

- (a) The own-price elasticities of demand for each meat, i.e. the percentage change in consumption of each type of meat resulting from a one per cent change in price of that meat.
- (b) The cross elasticities of demand of each meat, i.e. the percentage change in the consumption of each type of meat resulting from a one per cent change in the price of each other type of meat.
- (c) The income elasticities of demand of each meat, i.e. the percentage change in demand resulting from a one per cent change in consumers' incomes.

Estimates of these elasticities, and similar information on the demand for meat, are required for a number of reasons. Firstly they are needed to interpret correctly the meat marketing situation as it unfolds itself over time and to assist in making long term projections of demand and prices for meat. The information is also needed to establish the competitive position of one type of meat in relation to other types in the eyes of the British consumer; to develop the most effective advertising and promotion policies; and to schedule supplies to the market over the months of the year so as to maximise our sales revenue.

In the following sections we discuss first of all the data used in the analysis. In section 3 we describe the simple econometric model of consumer demand which is

tested and for which the results are given in sections 4, 5 and 6. The paper concludes with a brief discussion of some of the implications of the results, some of the problems as yet unresolved, and the further work required and under way.

Most of the detailed statistics and some notes on various aspects of the methodology are given in the Appendices.

II. BRITISH RETAIL MEAT CONSUMPTION DATA

There are two main sources of data for the analysis of factors affecting consumption and prices of meat in Britain. The first are the figures of total monthly, quarterly or annual "disappearance" of various types of meat, derived from statistics of imports, British production and changes in wholesale stocks. The second source of data, which have been used in this paper, are the statistics collected and published annually by the British National Food Survey and covering a random sample of British households.

The figures of annual supplies¹ of lamb and mutton and beef in Britain are given in Table I (overleaf) which shows the quantities supplied by New Zealand, Britain and other suppliers over the last five years.

¹ The figures given in the tables are supplies which, when adjusted by changes in stocks, give disappearance. The stock changes over a period of a year are however very small so that disappearance and supplies for such periods amount to virtually the same thing.

TABLE I

U.K. SUPPLIES OF LAMB & MUTTON AND BEEF & VEAL

<u>Lamb & Mutton</u>	1960	1961	1962	1963	1964
	000 tons				
<u>Imports</u>					
New Zealand	300.0	289.5	292.0	282.9	294.2
Australia	30.9	25.7	22.2	22.6	22.5
Others	44.3	31.6	38.1	37.3	23.4
Total Imports	375.2	346.8	352.3	342.8	340.1
U.K. Production	223.9	262.9	249.9	241.3	252.9
Total Supplies	599.1	609.7	602.2	584.1	593.0
Per Capita Supplies(lbs)	25.63	25.91	25.29	24.37	24.49
<u>Beef & Veal</u>					
<u>Imports</u>					
New Zealand	19.9	12.1	7.5	2.1	26.2
Australia	64.5	32.2	34.9	18.3	84.6
Argentina	203.5	152.9	180.9	235.8	149.1
Others	64.9	90.7	104.3	101.4	85.0
Total Imports	352.8	287.9	327.6	357.6	344.9
U.K. Production	819.9	890.6	903.7	929.2	869.1
Total Supplies	1172.7	1178.5	1231.3	1286.8	1214.0
Per Capita Supplies(lbs)	50.18	50.08	51.71	43.70	50.06

Source: C.E.C. Intelligence Bulletin

Data relating to supply or disappearance, for monthly or quarterly periods, could be used to analyse the effect, on wholesale prices, of changes in supplies of various types of meat and particularly the effects, on wholesale prices of New Zealand, of changes in supplies of the same type of meat from other competing suppliers. Such an analysis, using monthly and quarterly disappearance figures, is in progress and the results will be published in a forthcoming publication.¹ The disadvantage with this data, and with the analyses based on it, is that it can only be used with wholesale prices because there are no statistics of the retail prices charged for meat from various destinations or indeed even for fresh meat compared with frozen or chilled meat. Moreover it is desirable that our figures refer to periods shorter than one year and the figures of disappearance, when estimated on a monthly or quarterly basis, must be regarded as only an approximation to retail consumption.

The analysis of retail consumption, with which we are here concerned, must therefore be based on the second source of consumption data mentioned above, viz the Annual Report of the National Food Survey Committee, which does include retail prices paid for meat of different types but not, unfortunately, differentiated according to country of origin. The results contained in this paper are therefore concerned with the retail demand in Britain for five major types of meat regardless of origin. From this approach, useful information can be derived about

¹ This research is being conducted by Mr J.M.Chetwin of Lincoln College and reference to some of his preliminary results is made in later pages of this paper.

the substitution relationships between these major types of meat. More specific measurements relating to New Zealand meat alone must await a further publication.

The National Food Survey collects from a sample of British households, information on quantities purchased and expenditure for each of a wide range of foods, together with details on the composition of the household and the level of household income. Each household takes part in the survey for one week but the sample is continuously replaced so that information is available for quarters and whole years.¹

For our analysis we used the figures given for lamb and mutton, beef and veal, poultry and pork, these being the four carcass meat categories given. All the individual non-carcass meat² items given were aggregated into a non-carcass meat category. No distinction is made, in the data given by the National Food Survey for each type of meat, between fresh and frozen meat, and this must be borne in mind when interpreting the results.

¹ A detailed description of the Survey is given in Appendix A of "Domestic Food Consumption & Expenditure 1961", Annual Report of N.F.S. Committee, published by H.M.S.O.

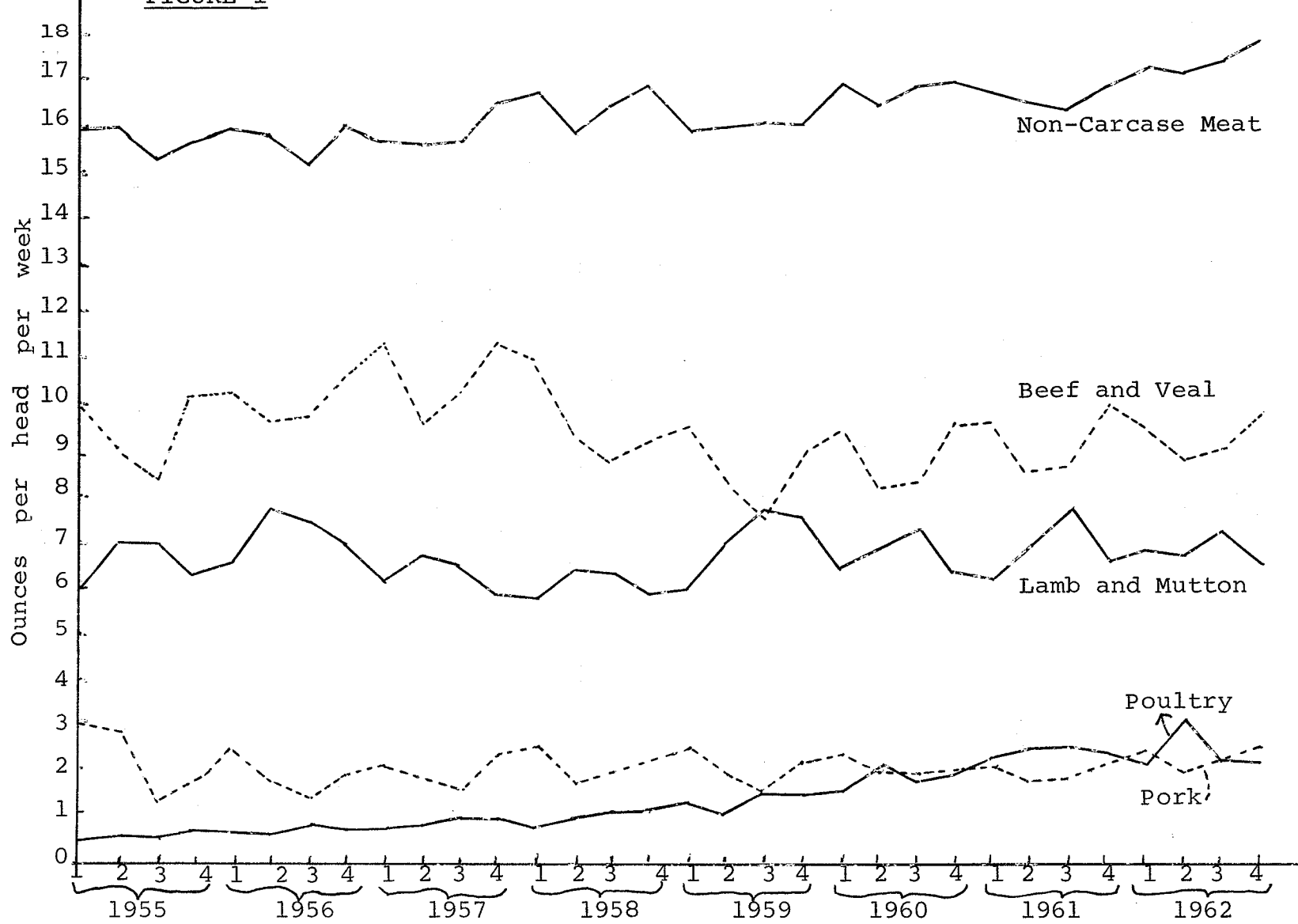
² Non-carcass meat consists of such items as corned meat, bacon and ham, liver, offals, rabbit, game and sausages.

Table 1 in the Appendix gives the full details of all the data collated from the National Food Survey Reports¹ for quarterly periods from 1955-1962, and Figure I shows the changes in quarterly per capita consumption, of each of the five types of meat, as measured by the survey.

III. THE DEMAND MODEL

To explore the effect on meat consumption of changes in prices, incomes, etc., using the National Food Survey data described above, regression equations were calculated in which the per capita consumption of meat was expressed as a function of the retail price of that meat, the retail price of other meats and the level of per capita income for the sample. All prices were divided by the British retail price index to allow for changes in the general price level, and the income figures were similarly deflated to measure changes in real income. All variables were transformed into logarithms so that the coefficients represent relationships between percentage or proportionate changes in the variables and therefore provide direct estimates of elasticities.

¹ In addition to the data given in the Reports, the National Food Survey also kindly provided further details especially relating to incomes and also provisional figures for later years in advance of the official release of the Reports.



Quarterly Levels of Consumption of Five Meats in U.K.

Preliminary covariance analysis of the data showed that there were definite seasonal changes in demand and to allow for these we included in the demand equations dummy variables to represent each quarter of the year. Our final model, using lamb and mutton as an example, is thus:

$$\begin{aligned} &\text{Log Consumption of Lamb and Mutton per head} \\ &= \text{Constant} - b \text{ Log Price of Lamb \& Mutton} \\ &\quad + c \text{ log index of price of other meats} \\ &\quad + d \text{ log real income per capita} \\ &\quad + eQ_1 + fQ_2 + gQ_3 \end{aligned}$$

where Q_1 , Q_2 and Q_3 are dummy variables for 1st, 2nd and 3rd quarters of the year, i.e. these variables assume a value of 1 in the relevant quarter and 0 in other quarters.¹

Similar equations were used for the other four meats, beef, pork, poultry and non-carcass meat.

In formulating the equations with consumption as the dependent variable for testing by single equation least squares, we have implicitly made the assumption that the direction of causation is one way, viz that changes in prices etc., affect consumption but changes in consumption

¹ The coefficients of the three dummy variables act in conjunction with the constant to measure changes brought about by season alone. The situation is equivalent to that in which there are four constants, one for each quarter. The constant for the fourth quarter is the constant of the equation, that for the first is the constant plus the coefficient for that quarter, similarly for the second and third quarters the constant is the equation constant plus the appropriate coefficient. So we end up with four constants each of which increases the log of consumption by the amount appropriate to the quarter.

do not affect prices. We have assumed, as it were, that in each quarter retail butchers set prices for various meats, and these prices, together with consumers' incomes, determine the amount bought by those consumers. Prices and incomes are thus regarded as predetermined variables and any disequilibrium shows itself in stock changes. This assumption would be untenable if our analysis was concerned with annual data, for over a period as long as this, in which stock changes are relatively small, the direction of causation is likely to be in the reverse direction. Consumption over a year (equal to supply because the market is usually cleared over a year) is predetermined and prices are the variables which are determined in such a way as to bring about a sale of retail consumption equal to supply.

But over a short period of 3 months, such as we are using here, in which changes in stocks can be significantly large, the assumption that retail butchers can supply whatever is demanded by consumers at whatever retail price is set, is not unreasonable.¹

In the two sections which follow we give two sets of results. In the first set, the prices of meats, other than the one analysed, are aggregated into one

¹ Nevertheless it is desirable to test the models using methods such as two stage least squares which take account of the possibility of such simultaneous relationships. This is now being done and results will be reported in a subsequent bulletin.

variable, e.g. "price of all meats other than lamb and mutton". In the second set an attempt is made to measure the separate effect of the price of each individual type of meat by disaggregating the "other meat" price variable.

IV. RESULTS - WITH AGGREGATED PRICES

In this section we give the results of testing regression equations of the form set out above, and the complete results of the analysis are given in appendix Table 2. Here we give equations for each of the five meats including only variables significant at least at the 5% level of significance.

Lamb and Mutton

The result for lamb and mutton is as follows:

(1)

$$\begin{aligned} \text{Log } C_L = & \text{Constant} - 1.37 \text{ Log } P_L + 1.29 \text{ Log } P_{NL} + 0.09Q_2 \\ & (.21) \qquad \qquad (.25) \qquad \qquad (.02) \\ & + 0.12Q_3 \qquad \qquad \qquad R^2 = 0.82 \\ & (.02) \end{aligned}$$

Where C_L = Per Capita consumption of Lamb and Mutton

P_L = Deflated Retail Price of Lamb and Mutton

P_{NL} = Deflated Retail price of all meat other than
Lamb and Mutton

Q_2 = Dummy Variable for second quarter

Q_3 = Dummy variable for third quarter

This equation indicates that on the average:

- (a) Other things equal a 1 per cent change in the retail price of lamb and mutton was associated with a 1.37 per cent change in retail consumption in the opposite direction. That is, the own-price elasticity of demand for lamb and mutton is -1.37.
- (b) Other things equal a 1 per cent change in the average retail price of all meat other than lamb and mutton was associated with a 1.29 per cent change in consumption of lamb and mutton in the same direction.
- (c) The two dummy variables indicate that in the second and third quarters the demand for lamb rises seasonally, with a proportionately greater rise in the third quarter compared to the second quarter.

The log of consumption is increased by .09 in the second quarter and by .12 in the third quarter. This has the effect of multiplying consumption by an amount equal to $e^{.09} = 1.09$ in the second quarter and $e^{.12} = 1.13$ in the third.

The coefficients of these variables are significant at the 1 per cent level, and the signs of the coefficients of lamb prices and non lamb meat prices are consistent with a priori expectation.

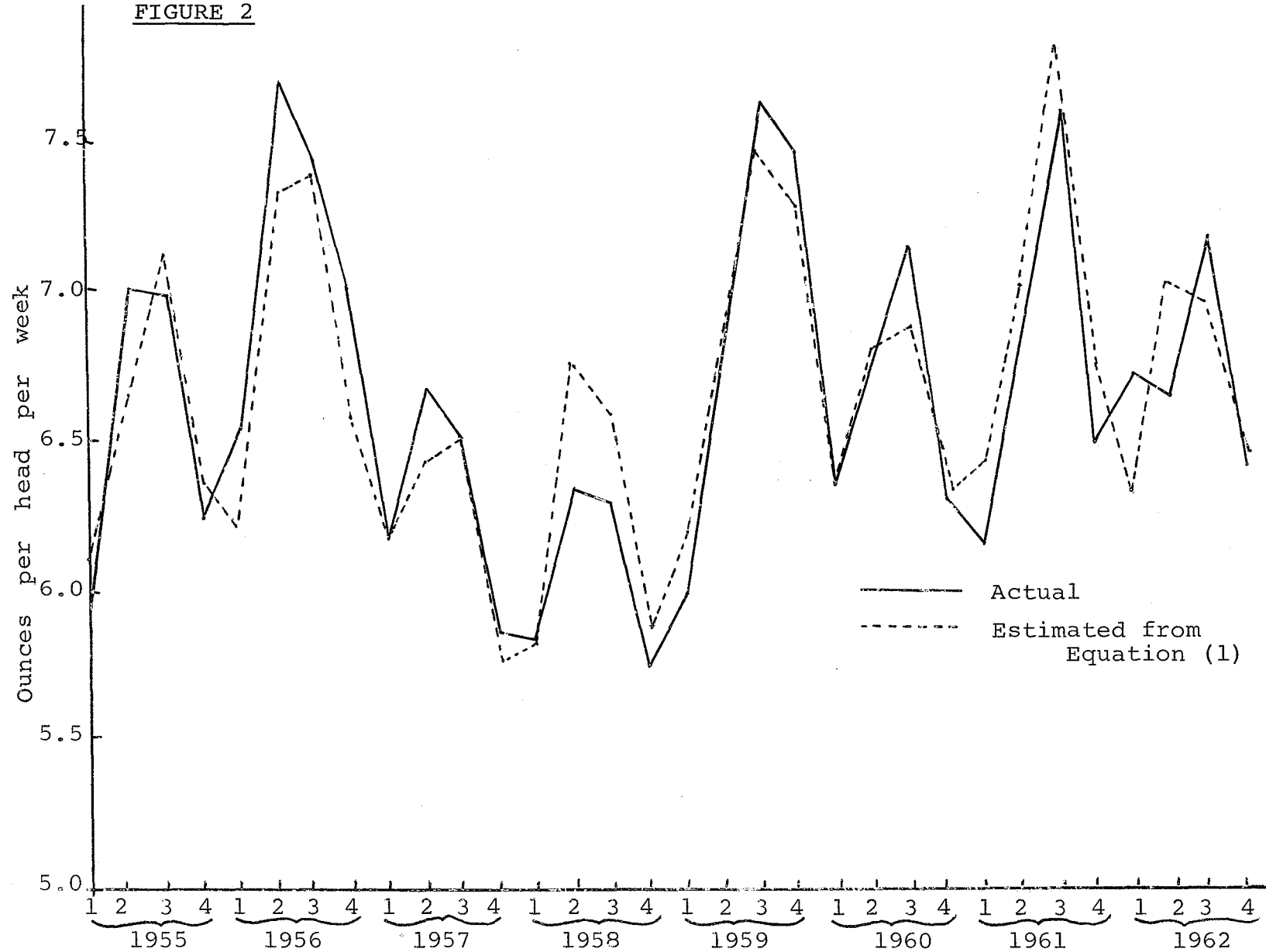
No significant relationship could be found in this analysis between consumption of lamb and mutton and per capita real incomes, the coefficient of income being very

low and not significantly different from zero. That income elasticities are low, though not necessarily zero, is confirmed by some estimates derived by other, and possibly more desirable, methods, viz cross sectional analysis of family budgets.¹ It should be remembered in this connection that our analysis is concerned with lamb and mutton. It is quite possible that income elasticities for mutton are negative and sufficiently large to offset positive income elasticities for lamb alone. It should not therefore be inferred from these results that the income elasticity of lamb is necessarily zero.

The degree of explanation of changes in lamb and mutton consumption afforded by equation (1) is shown in Figure 2, in which the values of consumption each quarter, as estimated from the equation, are compared graphically with the actual values. The major discrepancy between actual and estimated values occurs in 1958, possibly reflecting the interruptions due to dock strikes in that year.

¹ The results of such analysis, which will be published in due course, give income elasticities around 0.3. Mr J.M. Chetwin, in his study of meat prices at the wholesale level, also finds very low income elasticities for lamb and mutton.

FIGURE 2



Actual and Estimated Quarterly Consumption of Lamb and Mutton

Other Meats

The results of similar analyses for the other types of meat viz beef and veal, poultry, pork, and non-carcase meat are given in the following equations where only coefficients significant at 5% level or better are included. In Appendix Table 2 the full set of equations are presented including coefficients of non-significant variables.

In the equations shown below the following notation has been used for the subscripts for C(consumption) and P(price). Per Capita real income is denoted by Y.

B = Beef and veal	NB = Non-beef and veal meats
Py = Poultry	NPY= Non-poultry meat
Pk = Pork	NPk= Non-pork meat
NC = Non-carcase meat	C = all carcase meat

$$\begin{aligned}
 (2) \quad C_B &= \text{Const.} - 2.02P_B + 0.47P_{NB} + 0.43Y - 0.10Q_2 - 0.10Q_3 \\
 &\quad (.16) \quad (.18) \quad (.13) \quad (.01) \quad (.02)
 \end{aligned}$$

$$R^2 = 0.93$$

$$\begin{aligned}
 (3) \quad C_{PY} &= \text{Const.} - 2.53P_{PY} + 3.57Y \\
 &\quad (.35) \quad (.95)
 \end{aligned}$$

$$R^2 = 0.93$$

$$\begin{aligned}
 (4) \quad C_{Pk} &= \text{Const.} - 1.63P_{Pk} + 0.09Q_1 - 0.12Q_2 - 0.21Q_3 \\
 &\quad (.55) \quad (.04) \quad (.05) \quad (.05)
 \end{aligned}$$

$$R^2 = 0.83$$

$$\begin{aligned}
 (5) \quad C_{NC} &= \text{Const.} - 0.63P_{NC} + 0.28P_C + 0.31Y \\
 &\quad (.09) \quad (.11) \quad (.05)
 \end{aligned}$$

$$R^2 = 0.87$$

The own-price elasticities of demand are for beef and veal, -2.02; for poultry, -2.53; for pork, -1.63; and for non-carcase meat, -0.63.

Significant values for the coefficient of income, i.e. the income elasticity of demand, are found for all these meats except pork. The income elasticity for poultry at 3.57 is extremely high, even by comparison with quite high values secured from budget studies. There is some evidence of a strong positive time trend in the consumption of poultry and the income variable, being itself highly correlated with time, has thrown up a coefficient, part of which is a reflection of this time trend - even though the evidence from budget study suggests a high income elasticity for poultry.

The quarterly dummy variables indicate a significant seasonal decline in beef and pork demand in the summer months but there is no apparent seasonal effect with poultry.

Figures 3 to 6 which follow, give, as for lamb and mutton, the comparison of consumption levels estimated by the equations (2) to (5), with the actual values prevailing quarter by quarter. The least satisfactory explanation is achieved in the case of non-carcase meat and poultry and in the latter case there is clear evidence of the strong upward trend in consumption mentioned above.

FIGURE 3

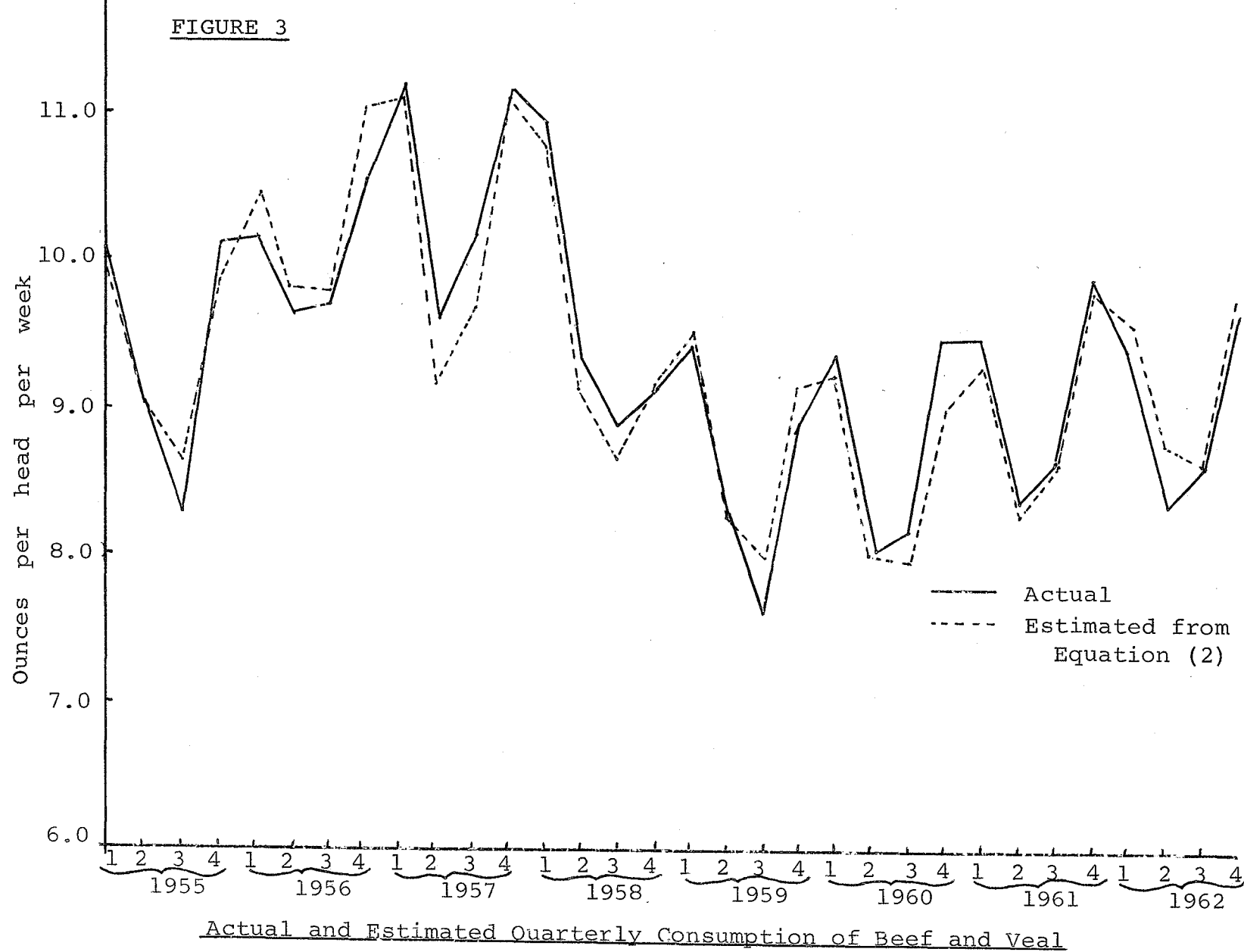


FIGURE 4

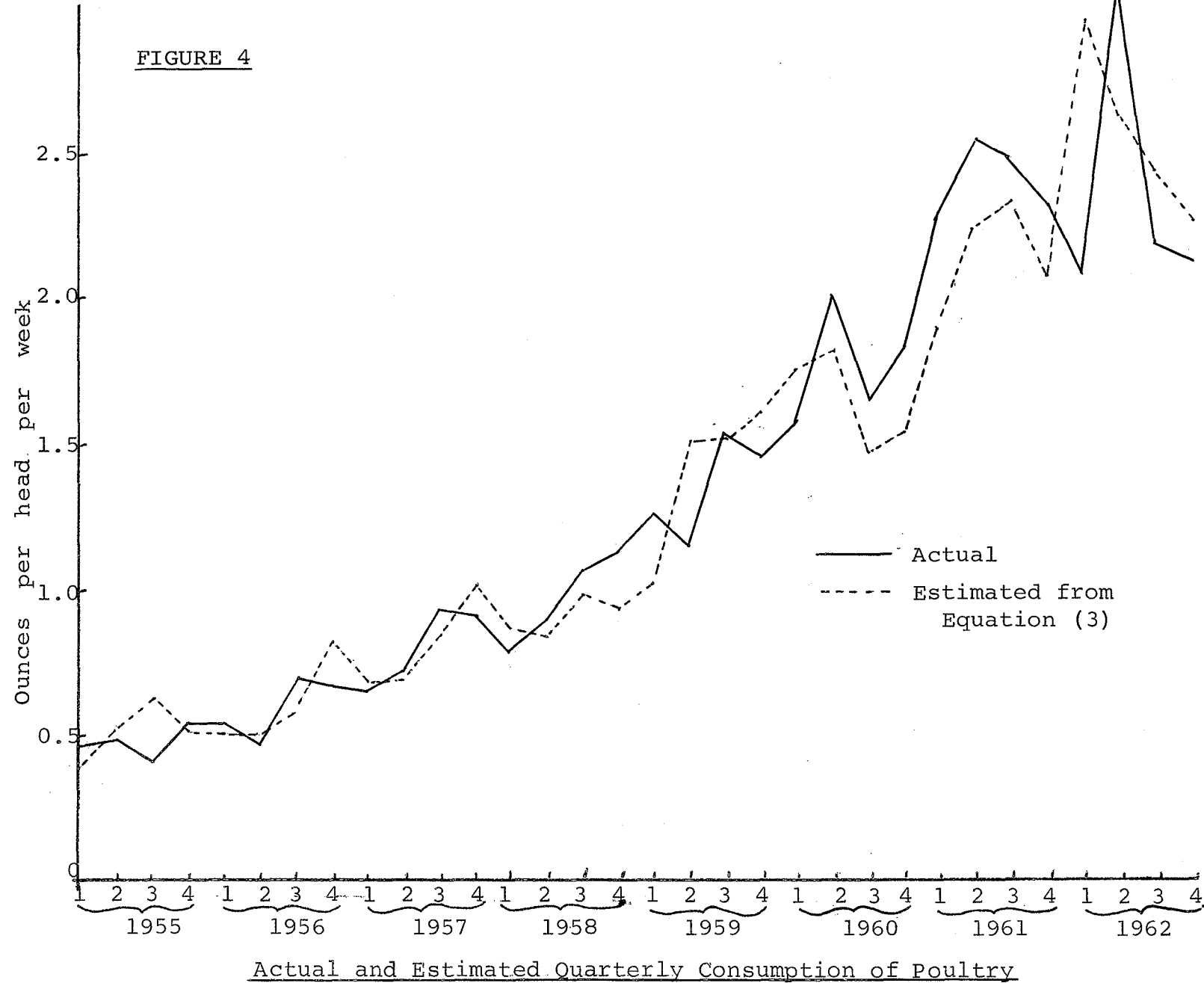
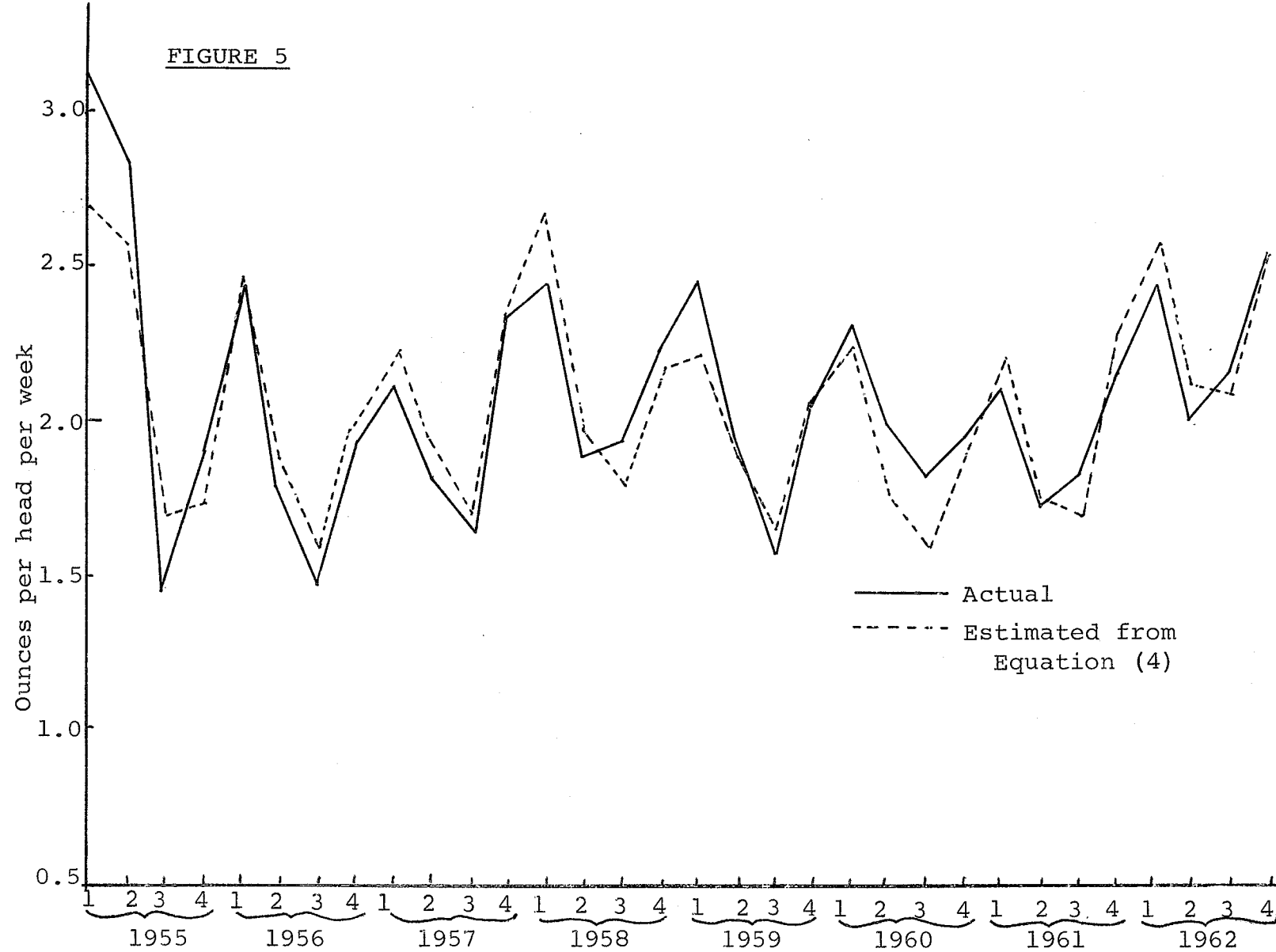
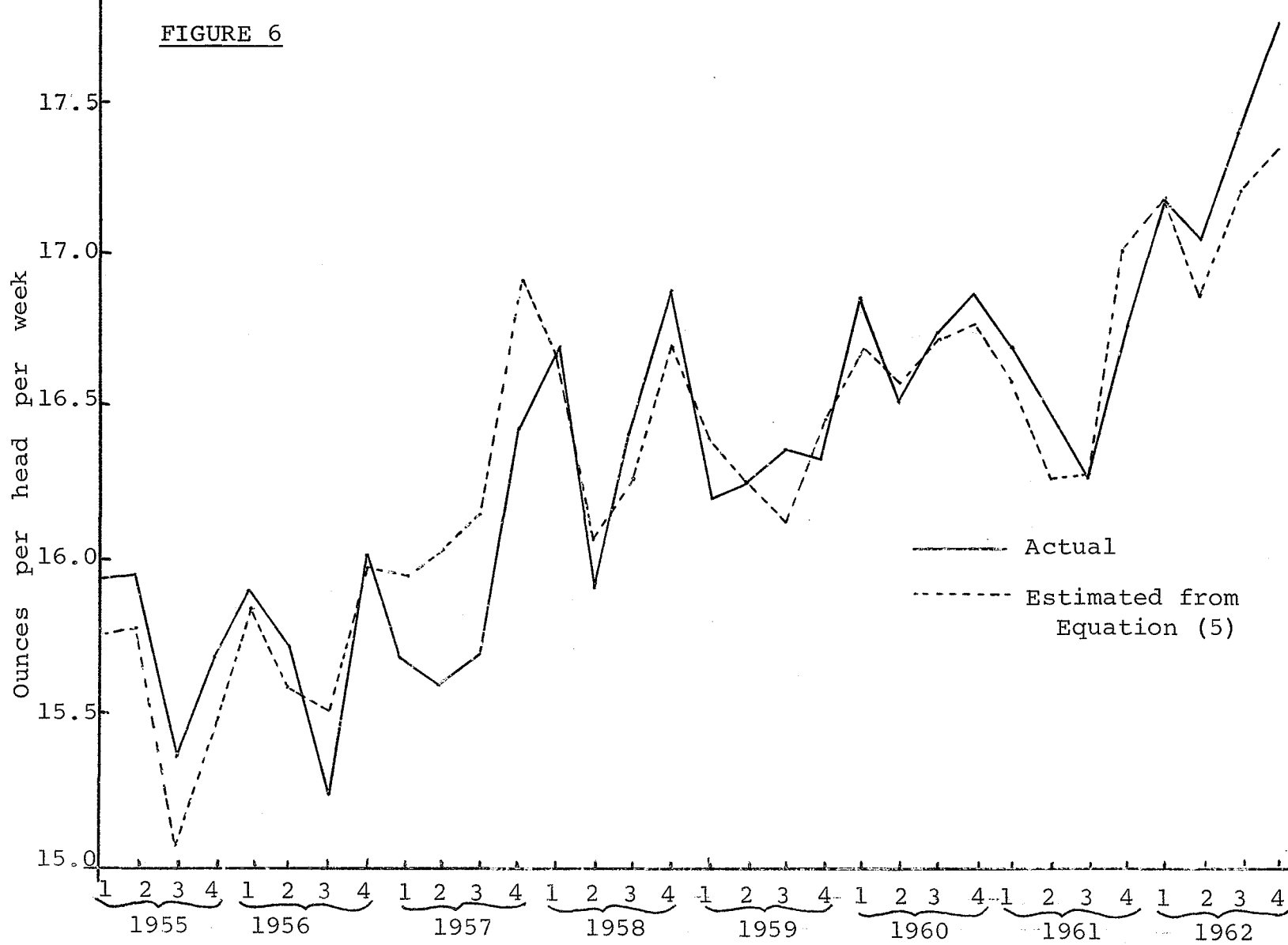


FIGURE 5



Actual and Estimated Quarterly Consumption of Pork

FIGURE 6

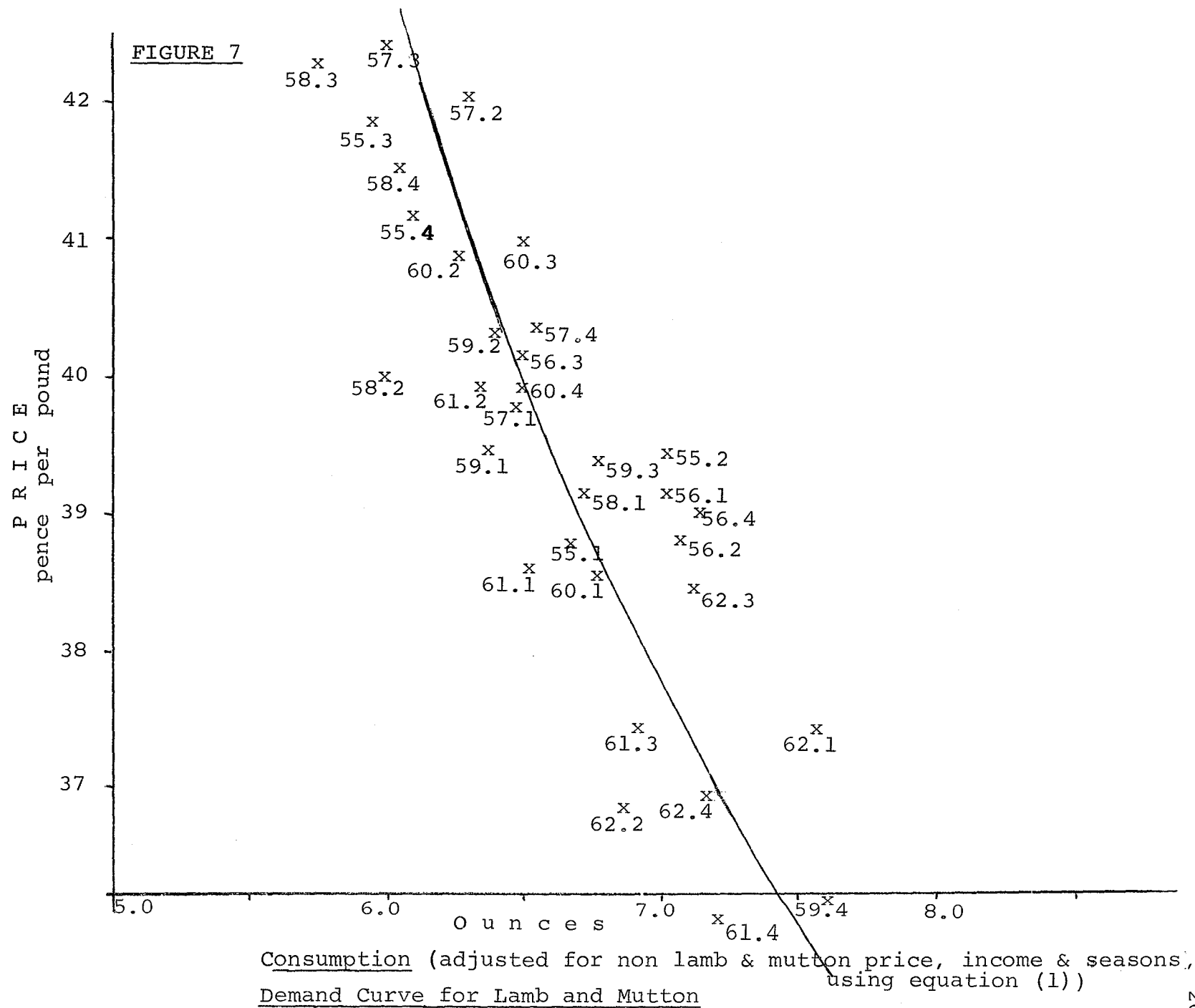


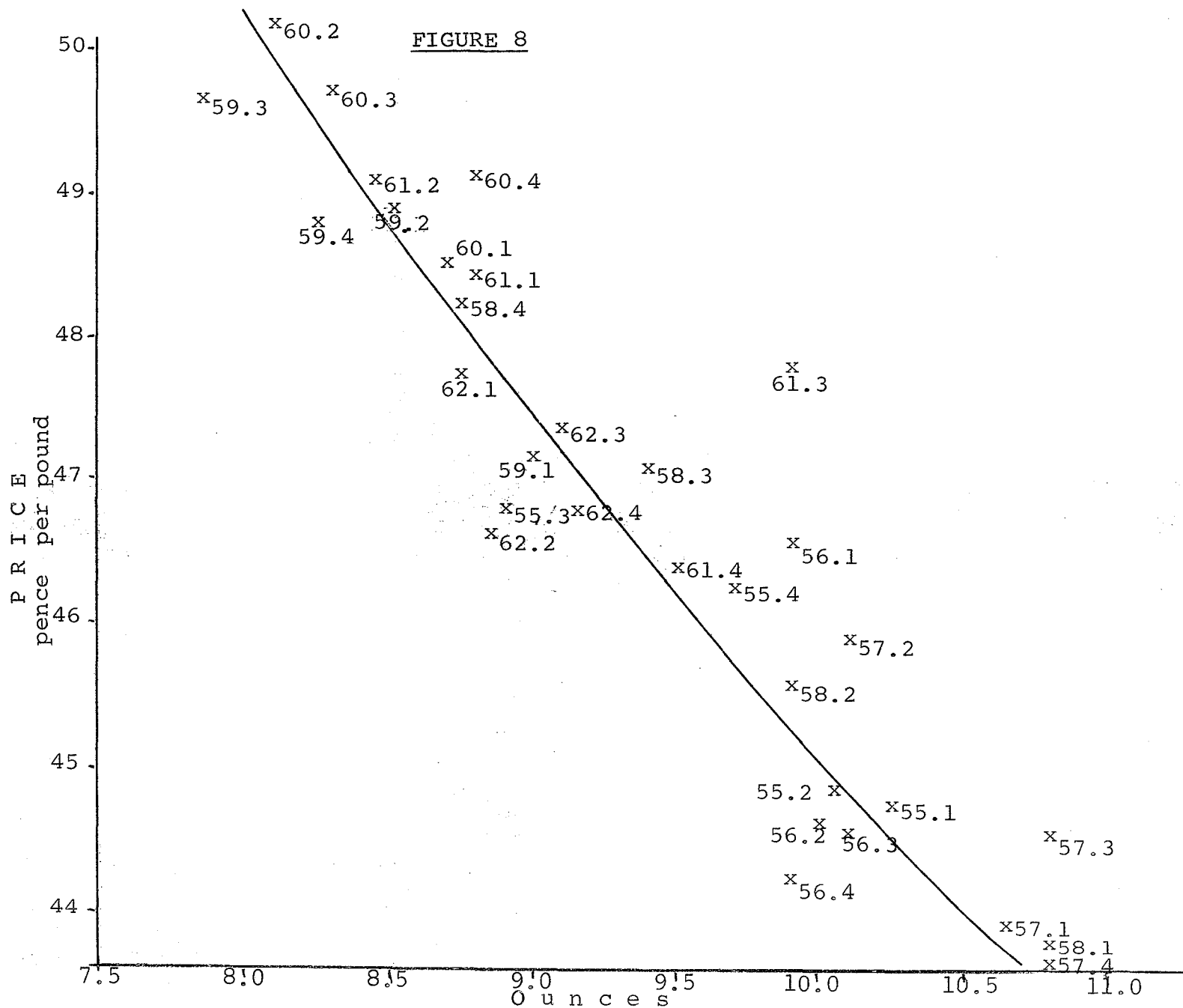
Actual and Estimated Quarterly Consumption of Non-Carcase Meat

V. THE DEMAND CURVE

In this section the results shown before for lamb and mutton and beef and veal, are presented diagrammatically in a slightly different way, viz in the form of the traditional demand curve of economic theory, reflecting the simple relationship, other things equal, between the price of a commodity and the consumption of it. Because there are variables other than own-prices affecting the consumption of these meats, an allowance must be made for the effect of these other variables before we can draw a two-dimensional diagram showing the simple price quantity relationship.

Figures 7 and 8 which follow, show for lamb and mutton and beef and veal respectively, the net relationship between consumption and price - the net relationship being calculated by correcting actual consumption in each quarter for the estimated effect of the other variables. For example in the calculations entering into Figure 7, we calculated for each quarter the quantitative effect on consumption of the actual level of the price of non lamb and mutton meat, and of the quarterly seasonal effect (using for this purpose the coefficients of equation (1)) and deducted this from the actual level of consumption to give consumption corrected for variables other than the price of lamb and mutton. This was then





Consumption (adjusted for non beef and veal price, income and seasons,
Demand Curve for Beef and Veal using equation (2))

plotted¹ against price to give the "demand curve" shown in Figure 7. A similar procedure was adopted for the demand curve for beef and veal shown in Figure 8.

VI. RESULTS - WITH DISAGGREGATED PRICES

In this section we give the results of attempting to carry the analysis a stage further by including separate variables for the price of each meat rather than, as before, aggregating them into one variable. The aim of this procedure is, of course, to measure, as far as it is possible, the complex set of substitution inter-relationships between prices and consumption levels of all five types of meat.

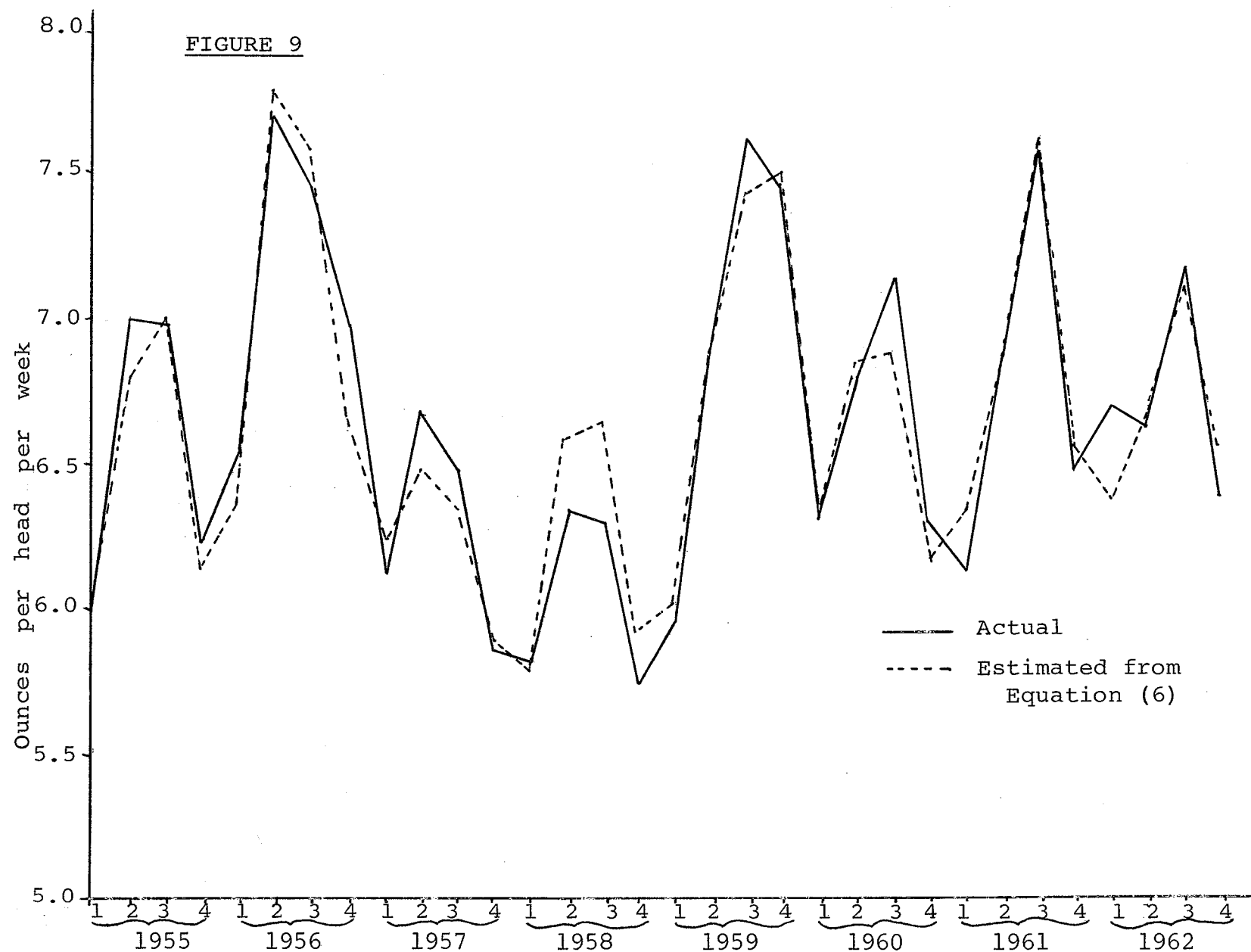
In Appendix Table 3 are given the full set of results from this analysis. In Table II following we give only the coefficients significant at 10% or better. In general the multiple correlation coefficients have improved - indicating that a greater proportion of the variance in consumption of each type of meat has been explained. This improvement in the degree of explanation is illustrated in Figures 9 to 13 where, as before, actual consumption levels for each of the five types of meat are compared with values estimated from equations (6) to (10).

¹ To this adjusted consumption is added a constant which is the coefficient of each of the adjusting variables multiplied by its mean. This brings the consumption figures back to their proper range.

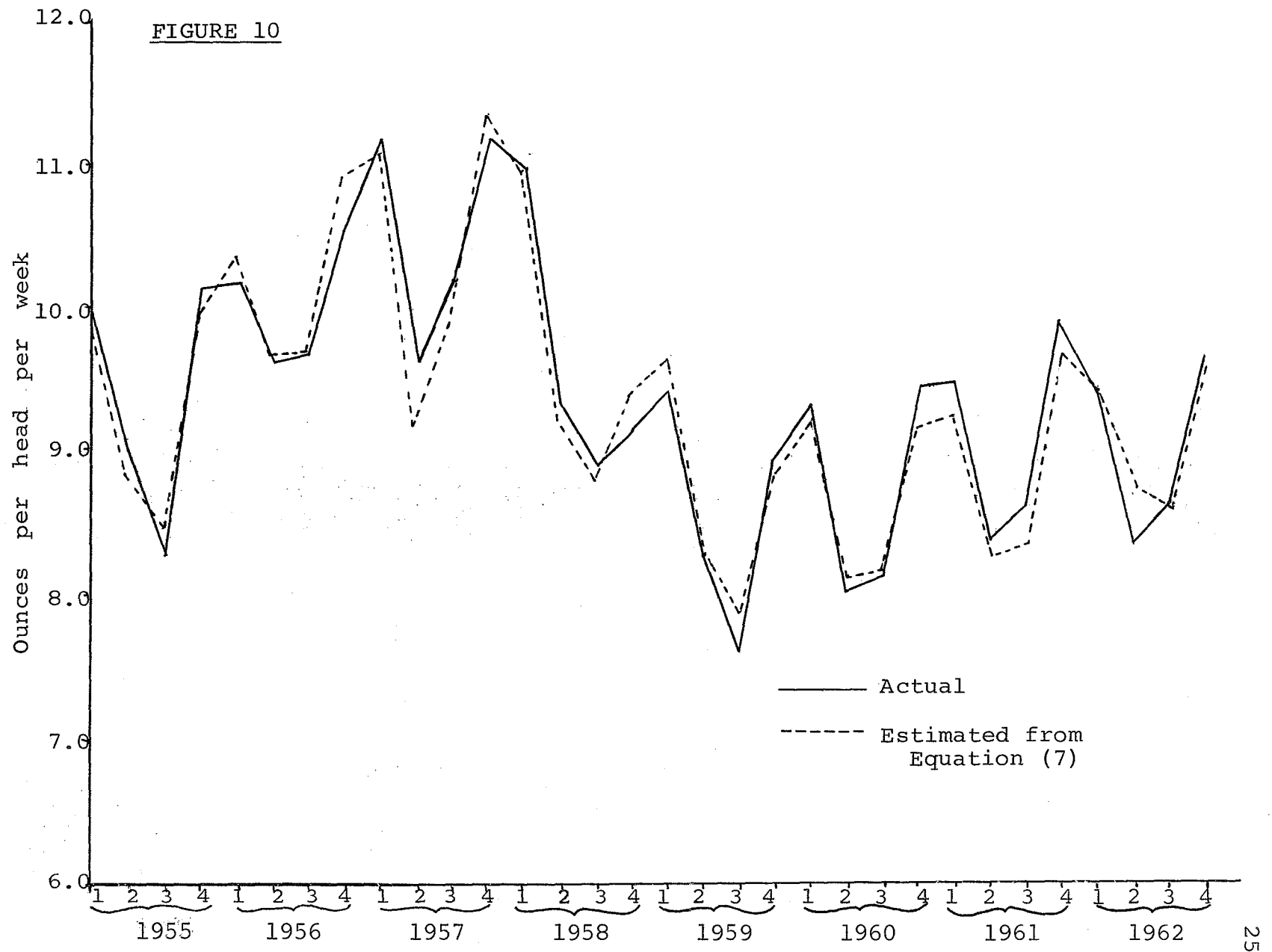
ELASTICITIES AND CROSS ELASTICITIES FOR MEAT IN UNITED KINGDOM

Dependent Variable	Log of Deflated Price of				Log of				R ²	
	Lamb & Mutton	Beef & Veal	Poultry	Pork	Non- Carcase Meat	Deflated Net Income	1st Season	2nd Season		3rd Season
Log of:										
Consumption of lamb & mutton	-1.43 (.18) **		.24 (.09) *	- .54 (.20) *	1.44 (.30) **	.77 (.20) **		.06 (.02) **	.10 (.02) **	.91
Consumption of beef & veal	.38 (.16) *	-1.96 (.19) **		.30 (.17) *		.33 (.18) *		- .09 (.01) **	- .09 (.02) **	.95
Consumption of poultry		2.26 (1.06) *	-1.80 (.41) **	3.91 (.96) **	-5.42 (1.45) **			.24 (.08) **	.33 (.10) **	.96
Consumption of pork		1.63 (.53) **	.42 (.20) *	-1.25 (.48) *	-2.65 (.72) **			- .12 (.04) **	- .18 (.05) **	.89
Consumption of non-carcase meat		.34 (.09) **			- .53 (.13) **	.26 (.08) **				.92

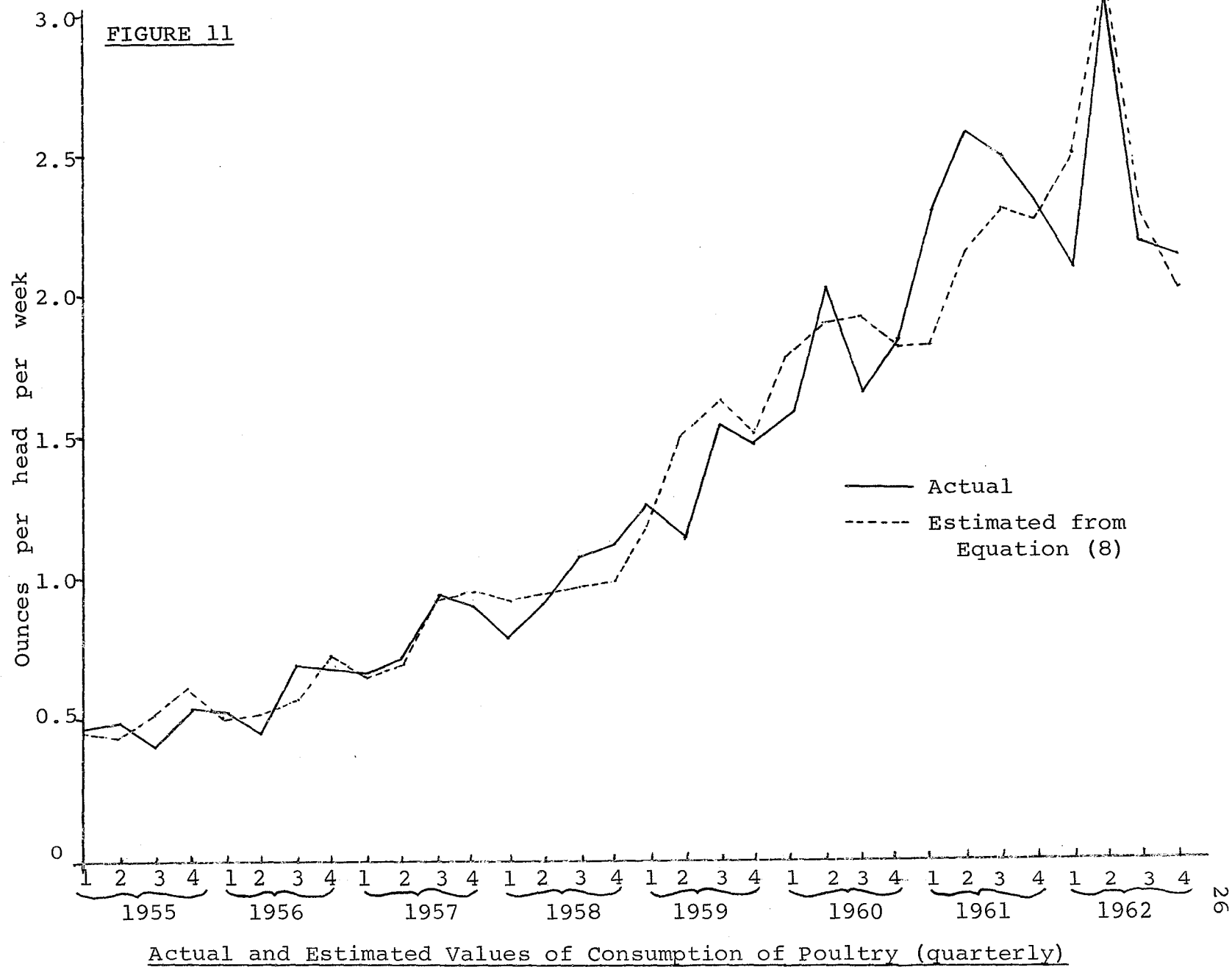
Note: Appendix Table 3 gives the full set of coefficients for the above equations in which are included only those variables significant at 10 per cent or better.



Actual and Estimated Values of Consumption of Lamb and Mutton (quarterly)



Actual and Estimated Values of Consumption of Beef and Veal (quarterly)



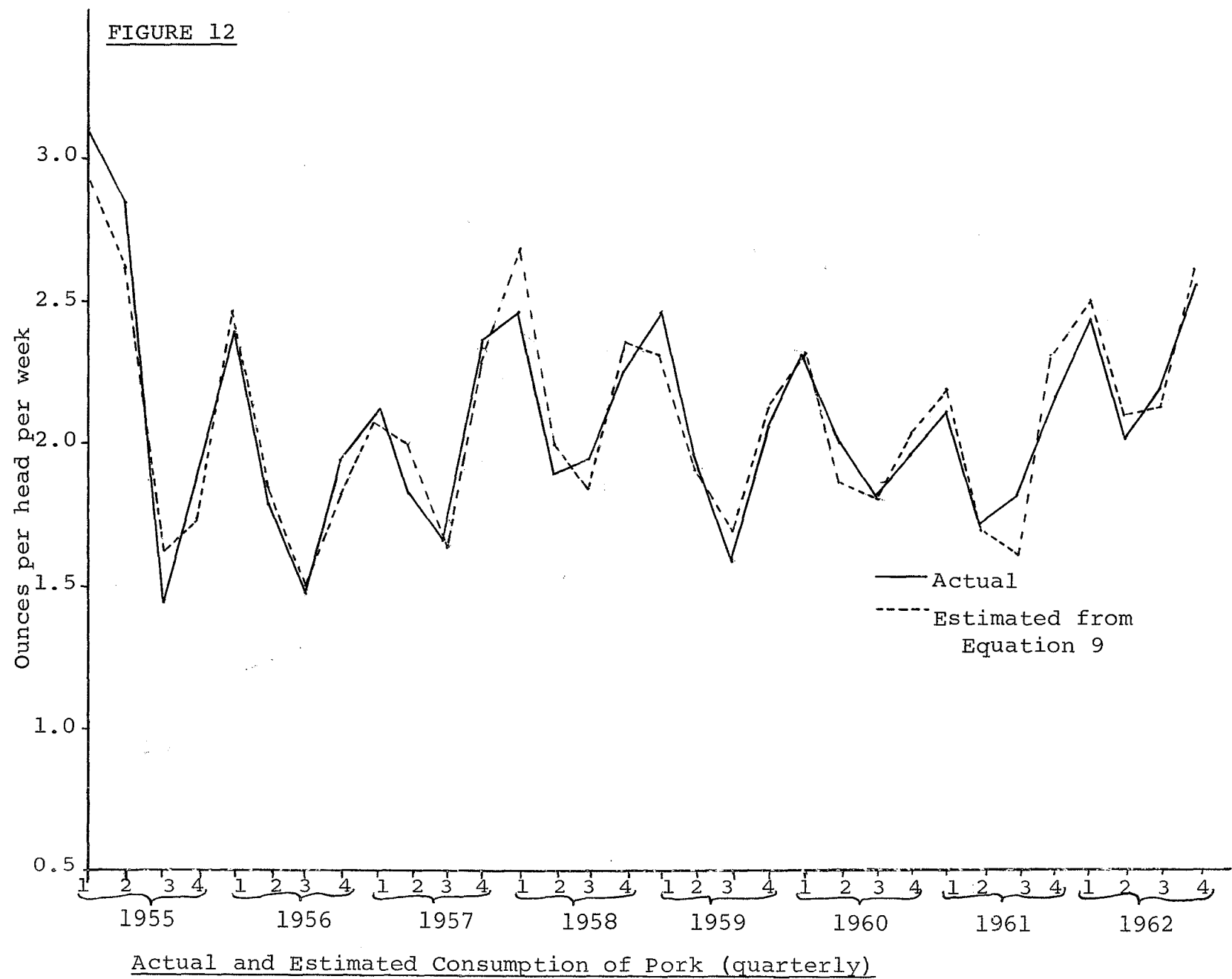
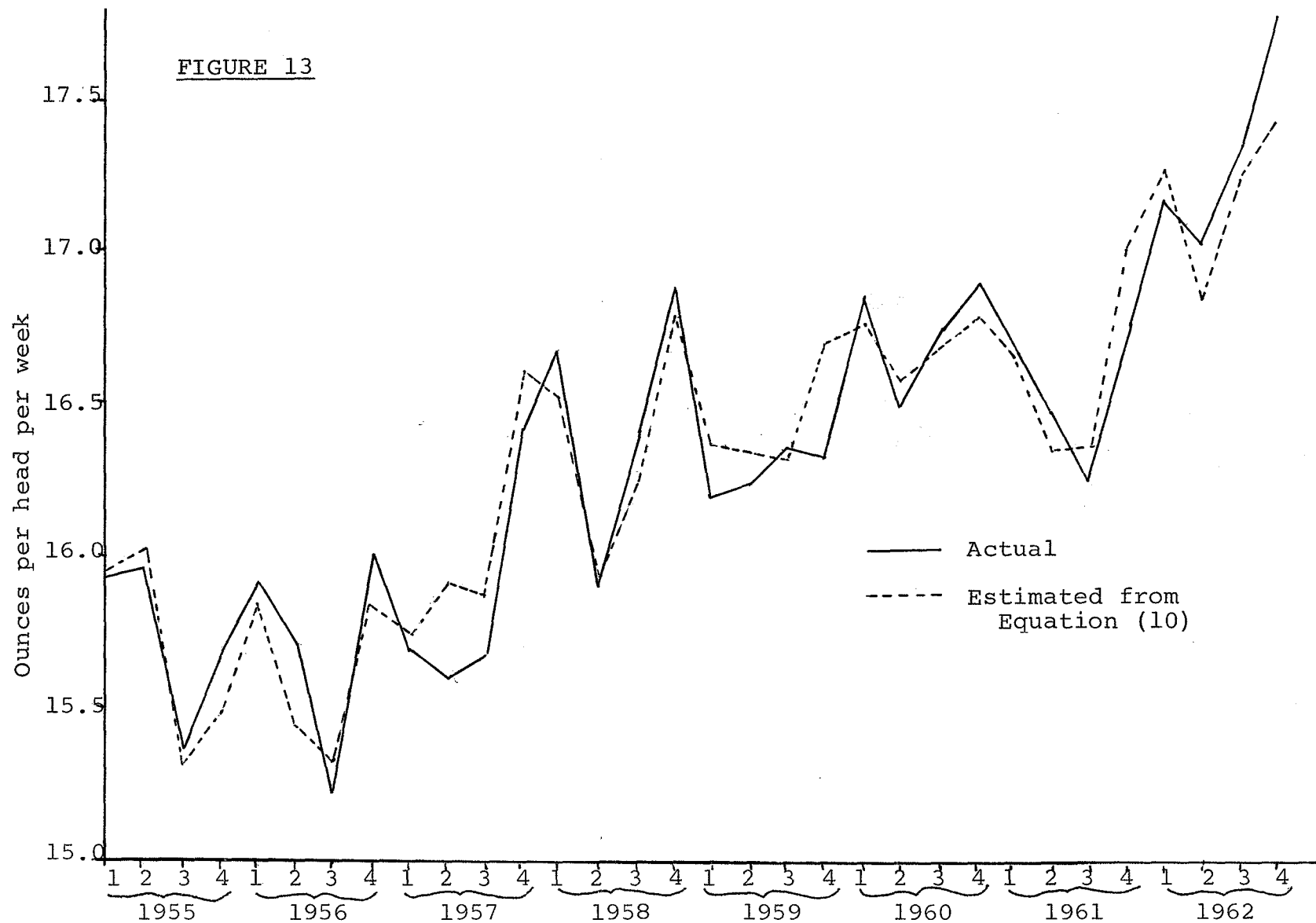


FIGURE 13



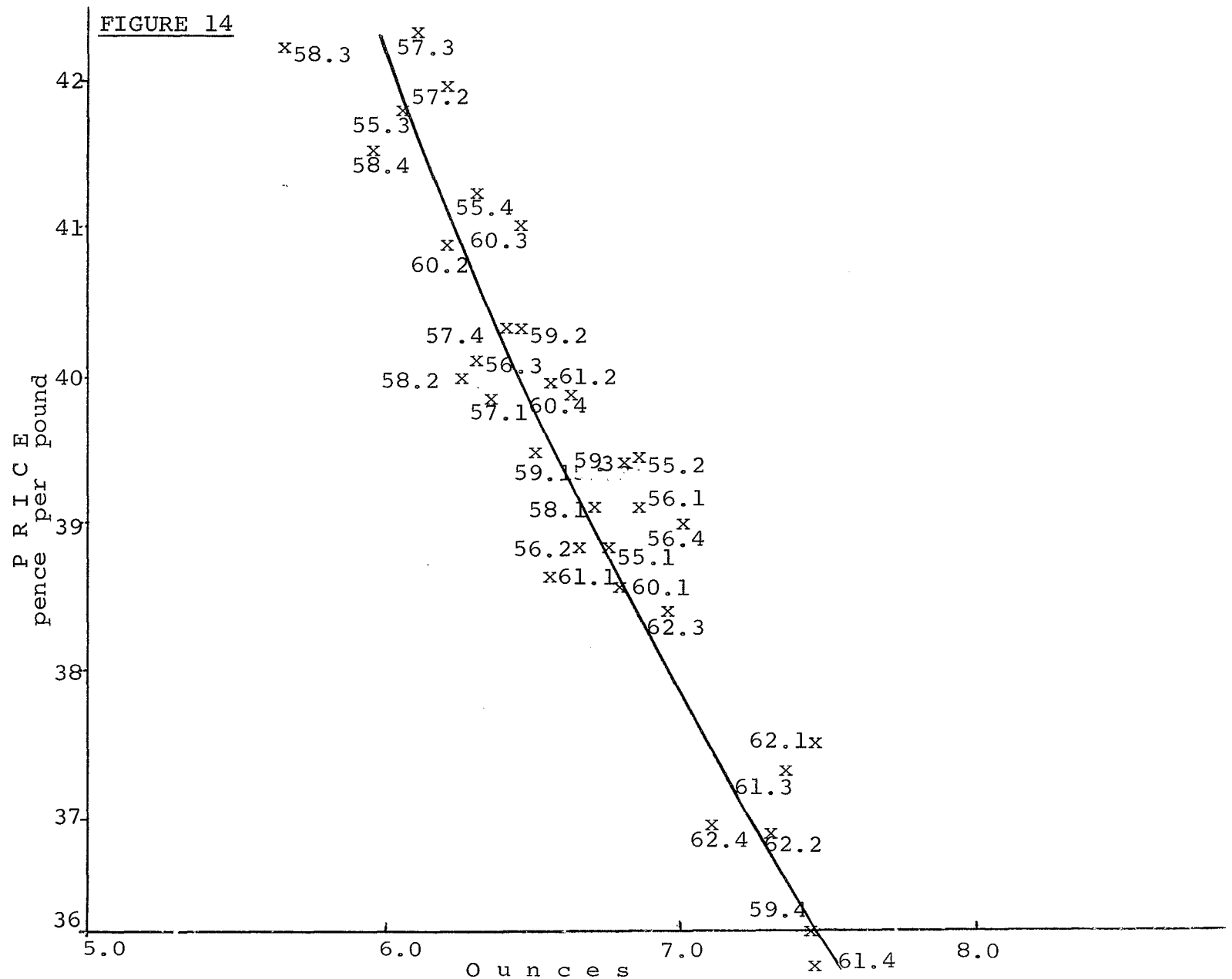
Actual and Estimated Values of Consumption of Non-Carcase Meat (quarterly)

The improvement in degree of explanation is also illustrated in Figures 14 and 15 which show, as before, the "demand curve" for lamb and mutton and beef and veal.

The seasonal effects are much the same as in the previous analysis. A very significant summer rise in demand for poultry now appears. All variables (except the seasonal quarterly variables) are expressed in logarithms and the coefficients are therefore elasticities.

The own-price elasticities, as given on the diagonal of the table, are in most cases much the same as before, with marked reductions however in the case of poultry and pork. The set of cross elasticities present a varied picture. Many of them are significant and of the expected sign, but three of them are significantly negative, viz the cross elasticities of lamb and mutton consumption with respect to the price of pork;¹ and the cross elasticities of poultry and pork consumption with respect to the price of non-carcase meat. It should be noted that the non-carcase meat variable includes a large amount of ham, cooked pigmeat and cooked poultry. This means that the price of non-carcase meat is not likely to be completely independent of the price of pork or of the price of poultry, and so may account for the negative cross elasticities of non-carcase meat with poultry and pork in equations (8) and (9).

¹ This perverse negative cross elasticity between lamb and mutton and pork prices is also found by J.A.C.Brown in an earlier study using similar data - "Seasonality and Elasticity of Demand", J.A.C.Brown, Journal of Agricultural Economics, vol.13, no.3, 1959.



Demand Curve for Lamb and Mutton

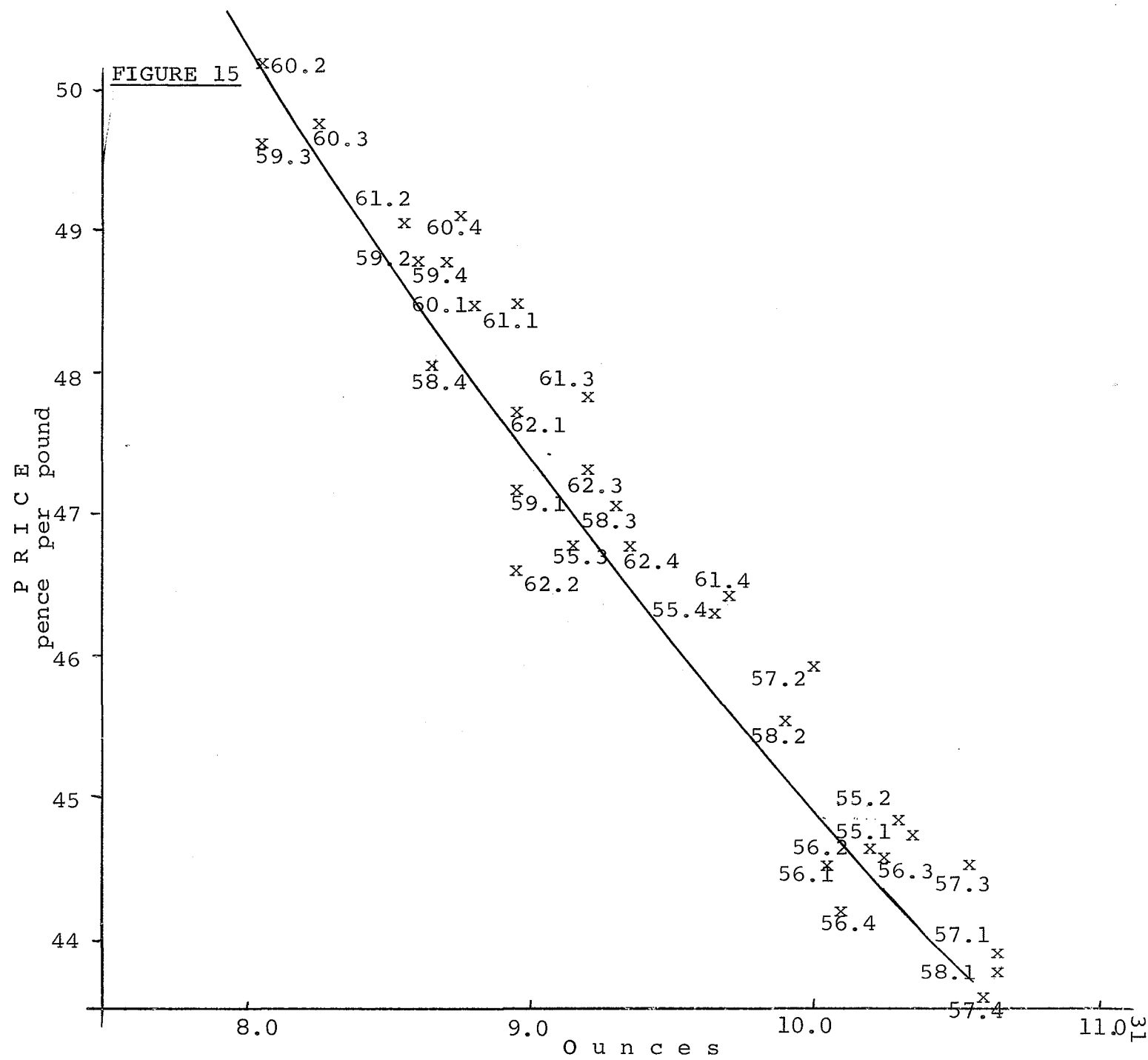


FIGURE 15
Consumption (adjusted for non beef and veal prices, income and season,
 Demand Curve for Beef and Veal (using equation (7))

It should also be noted that there does not appear to be a significant value for the cross elasticity of lamb consumption with respect to beef prices - i.e. lamb and beef do not appear to be substitutes in consumption.¹

As far as income elasticities are concerned, non-significant values were obtained for poultry and pork. The income elasticity for non-carcase meat is approximately the same as in the previous analysis. The beef income elasticity at 0.33 is slightly lower but only significant at 10 per cent level. For lamb and mutton the income elasticity (which in the previous analysis was not significantly different from zero) is now estimated at 0.77.

This result, and indeed all the coefficients in this second analysis, must be treated with some caution. With the large number of variables used, there is necessarily a high degree of inter-correlation between the variables and less reliability can be placed in the results than in the results of the first aggregated analysis presented. A more detailed and precise examination of the equations relating to each meat is being conducted to overcome this problem whereas our purpose

¹ This surprising conclusion is borne out by Mr J.M. Chetwin's provisional results of an analysis of inter-relationships between meat prices at wholesale level - referred to before. No relationship between demand for lamb and price of beef can be found even for fresh beef and chilled beef separately.

here is to present for all meats the equations calculated on the same basis.¹

VI. IMPLICATIONS

The results given above, while by no means conclusive, (especially as far as income elasticities are concerned) indicate that retail meat consumption in Britain is very responsive to price changes. Reliable estimates of own-price elasticities have been secured and these are relatively high. Less reliability attaches to the estimates of cross elasticities on which further research is required. Nevertheless there is clear evidence of a high degree of substitution between different meats. This fact needs to be borne in mind when diagnosing the current meat situation, or when making longer term forecasts and projections.

In connection with forecasting and projection work, it should be mentioned that the model analysed above is not the best that could be designed for this purpose. Apart from the general point that no econometric model should strictly be used to forecast outside the range of variation examined by the model,² there is the specific

¹ It is also proposed to impose certain restrictions on the coefficients of these equations. In the first place we can use income elasticities extraneously estimated from budget data, and secondly certain relationships between the cross elasticities as derived from the theory of consumer demand can be imposed.

² Though, in the nature of the case, most economic investigations do not allow the economist much option but to do this.

point that New Zealand has control over the supply of meat but no control over the price charged. A thoroughgoing forecasting model should therefore proceed by analysing the effect on wholesale prices of changes in supplies - so giving a wholesale price flexibility,¹ rather than a price elasticity of demand - indeed it should go even further and explain the whole process of pricing from the arrival of supplies at wholesale to their final absorption at retail. Such a model has been formulated and is now being tested.²

However, the present retail elasticities do give a tentative basis for exploring long run price projections for lamb and mutton in Britain. The own-price elasticity of demand for a commodity (being a measure of the proportional change in consumption divided by proportional change in price) gives a measure of the amount by which retail price must fall if increased supplies of a commodity are to be shifted into consumption. For example the estimate of the own-price elasticity of demand for lamb and mutton of -1.4 implies that a 1 per cent fall in the retail price of lamb and mutton will lead to a 1.4 per cent rise in consumption - or, inverting

¹ Price flexibility is the inverse of price elasticity of demand; it measures the percentage change in price resulting from a 1 per cent change in supply. It is interesting to note that the wholesale price flexibility of 1.4 for lamb and mutton derived in earlier work (B.P. Philpott "Economic Research into Fat Lamb Prices", Proceedings Lincoln College Farmers' Conference 1961) implies a wholesale price elasticity of demand of 0.7. This figure, when one allows for the relative fixity and size of the retail marketing margin, is reasonably consistent with the retail elasticity of 1.4 given above.

² In the work by J.M. Chetwin referred to before.

the expression, a 0.7 fall in price will lead to a 1 per cent rise in consumption. If, over the next five years say, supplies of lamb and mutton were expected to rise 10 per cent, then, other things equal, retail prices would have to fall 7 per cent in order to induce consumers to absorb the increased supplies into consumption. On this basis a provisional assessment could be made of the implications for retail prices of possible future levels of lamb and mutton supplies.

At this point however we must remind ourselves that the price changes for any one meat will be determined, not only by supply changes for that meat, but also by the supply and price changes for all other meats due to the substitution relationships discussed before, and also by income changes and income elasticities of demand. In other words a thoroughgoing price projection would need to be couched along the lines of this question - "Given certain projected changes in consumers' incomes and the supplies of lamb, beef, pork, poultry and non-carcase meat, and given the income price, and cross elasticities of demand, what new set of prices would just clear the market of all meat supplied?" Such an analysis, using the results in this bulletin, is at present under way, even though it may need amendment, as our estimates of price and cross elasticities of demand become more precise and reliable by further work aimed at meeting some of the objections already raised.

This further work, some of which is now in hand, includes such matters as the imposition of theoretical

restrictions on the coefficients; the use of estimating techniques to take account of possible simultaneous relationships relating to any one meat or to all five of them; the analysis of demand specifically for New Zealand meat by using disappearance figures; and lastly the measurement of differences in demand for lamb and mutton as between different regions in Britain.

Such provisional results as are already to hand in this work, and which will be reported in later bulletins, indicate no great need to amend the figures given above and these can therefore be used to assist in framing policy which unfortunately cannot usually wait for the final word in these matters.

APPENDIX TABLE 1

DATA USED IN DEMAND ANALYSES

	Consumption of					Average price deflated by U.K. Retail Price Index										Deflated
	Lamb & Mutton ₁	Beef & Veal ₁	Poultry ₁	Pork ₁	Non- Carcase Meat ₂	Lamb & Mutton ₂	Beef & Veal ₂	Poultry ₂	Pork ₂	Non- Carcase Meat ₂	Non- Lamb & Mutton ₂	Non- Beef & Veal ₂	Non- Poultry ₂	Non- Pork ₂	All Carcase Meat ₂	Net Income ₂
	ounces per head per week					pence per pound										£/head/wk
1955																
1st Quarter	5.99	10.02	0.47	3.12	15.93	38.80	44.75	64.86	42.01	41.33	42.94	41.25	41.94	42.26	42.98	3.79
2nd "	7.00	9.00	0.48	2.85	15.95	39.44	44.83	60.24	38.27	41.77	42.71	41.11	41.81	42.39	42.30	3.97
3rd "	6.98	8.28	0.42	1.43	15.34	41.82	46.79	56.23	43.58	46.77	46.75	45.32	45.56	45.79	44.73	3.93
4th "	6.23	10.12	0.54	1.88	15.67	41.24	46.29	60.78	49.74	45.94	46.60	45.36	45.39	45.39	45.38	4.07
1956																
1st "	6.52	10.16	0.53	2.40	15.90	39.12	44.56	64.87	44.78	42.78	43.97	42.49	42.75	42.96	43.33	4.08
2nd "	7.68	9.62	0.46	1.79	15.71	38.83	44.63	70.02	45.82	44.97	45.33	43.64	43.57	43.81	43.06	4.36
3rd "	7.45	9.69	0.69	1.47	15.22	40.17	44.55	64.69	46.84	46.15	46.09	44.91	44.41	44.72	43.76	4.26
4th "	6.98	10.54	0.67	1.94	16.00	39.04	44.20	57.06	48.18	44.57	44.96	43.67	43.57	43.57	43.22	4.42
1957																
1st "	6.11	11.20	0.66	2.13	15.68	39.85	43.89	61.73	47.75	43.46	44.34	43.42	43.23	43.31	43.66	4.27
2nd "	6.66	9.60	0.71	1.82	15.60	42.00	45.91	61.23	45.06	43.59	44.94	43.78	44.02	44.33	45.02	4.29
3rd "	6.48	10.17	0.93	1.64	15.68	42.33	44.53	56.01	46.62	43.74	44.59	44.02	43.85	44.05	44.53	4.29
4th "	5.85	11.19	0.90	2.34	16.42	40.34	43.59	53.88	45.61	41.15	42.75	41.82	42.07	42.14	43.35	4.51
1958																
1st "	5.82	10.96	0.78	2.46	16.66	39.12	43.78	55.63	44.57	40.18	42.20	40.83	41.41	41.50	42.99	4.27
2nd "	6.34	9.31	0.90	1.89	15.89	39.99	45.59	55.80	45.26	42.93	44.39	42.83	43.24	43.48	44.13	4.26
3rd "	6.28	8.88	1.07	1.94	16.40	42.23	47.08	53.46	44.76	43.90	45.32	43.96	44.48	44.76	45.54	4.34
4th "	5.73	9.12	1.12	2.24	16.87	41.52	48.03	53.74	46.18	42.68	45.03	43.20	44.15	44.34	46.11	4.40
1959																
1st "	5.95	9.42	1.26	2.46	16.19	39.49	47.17	53.65	48.37	42.45	44.94	42.88	43.67	43.70	45.36	4.30
2nd "	6.87	8.26	1.14	1.96	16.24	40.28	48.85	48.67	46.74	43.94	45.80	43.39	44.56	44.58	45.38	4.54
3rd "	7.61	7.59	1.54	1.56	16.35	39.38	49.63	47.27	47.40	44.98	46.56	43.68	44.87	44.86	44.98	4.47
4th "	7.45	8.92	1.46	2.05	16.32	36.23	48.80	46.74	47.72	44.00	45.89	42.30	43.78	43.67	43.83	4.64
1960																
1st "	6.33	9.33	1.58	2.31	16.85	38.63	48.49	46.91	48.83	42.50	45.08	42.39	43.82	43.63	45.22	4.58
2nd "	6.79	8.02	2.02	1.99	16.49	40.90	50.13	48.02	48.88	44.09	46.40	43.94	45.18	45.13	46.45	4.74
3rd "	7.13	8.14	1.64	1.82	16.74	41.02	49.71	50.12	49.05	43.74	46.17	43.77	44.89	44.92	46.38	4.62
4th "	6.28	9.46	1.83	1.95	16.87	39.90	49.11	47.05	50.45	43.34	45.84	43.30	44.70	44.50	46.09	4.59
1961																
1st "	6.12	9.49	2.30	2.12	16.68	38.68	48.43	45.43	49.01	42.85	45.20	42.61	44.03	43.81	45.17	4.56
2nd "	6.85	8.36	2.56	1.71	16.47	39.96	49.09	43.06	48.87	44.32	45.85	43.40	44.85	44.52	45.07	4.65
3rd "	7.58	8.63	2.49	1.81	16.25	37.37	47.81	41.46	47.69	44.22	45.26	42.35	43.79	43.42	43.17	4.61
4th "	6.46	9.90	2.32	2.15	16.75	35.98	46.37	41.49	46.87	40.96	43.13	40.30	41.93	41.60	42.66	4.59
1962																
1st "	6.69	9.40	2.09	2.43	17.15	37.48	47.72	40.44	46.81	40.89	43.39	40.56	42.45	42.03	43.55	4.78
2nd "	6.62	8.35	3.09	2.00	17.02	36.89	46.66	39.23	46.11	40.58	42.47	39.97	41.68	41.21	42.24	4.60
3rd "	7.16	8.65	2.20	2.17	17.33	38.45	47.34	42.13	43.72	41.18	43.18	40.76	42.29	42.19	43.23	4.74
4th "	6.39	9.63	2.14	2.55	17.75	36.97	46.80	41.64	44.83	40.61	42.87	40.25	41.91	41.68	43.00	4.74

¹ Data taken directly from National Food Survey Reports

² Data calculated from figures provided by the National Food Survey. Prices and Income are deflated by the retail price index taken from the Great Britain Monthly Digest of Statistics.

APPENDIX TABLE 2

COMPLETE SET OF REGRESSION COEFFICIENTS FROM "AGGREGATED" DEMAND ANALYSES

Dependent Variable	Log of Deflated Price of:		Log Real Disposable Income	1st Season	2nd Season	3rd Season	Constant	R ²
Log of Cons. of:								
	<u>Lamb & Mutton</u>	<u>Non Lamb & Mutton</u>						
Lamb and Mutton	-1.37 (.21) **	1.29 (.25) **	-.03 (.14)	-.01 (.02)	.09 (.02) **	.12 (.02) **	1.53	.82
	<u>Beef & Veal</u>	<u>Non Beef & Veal</u>						
Beef and Veal	-2.02 (.16) **	.47 (.18) *	.43 (.13) **	.01 (.02)	-.10 (.01) **	-.10 (.02) **	2.50	.93
	<u>Poultry</u>	<u>Non-Poultry</u>						
Poultry	-2.53 (.35) **	.38 (1.21)	3.57 (.95) **	.15 (.09)	.10 (.09)	.09 (.09)	9.85	.93
	<u>Pork</u>	<u>Non-Pork</u>						
Pork	-1.63 (.55) **	-1.24 (.86)	.51 (.46)	.09 (.04) *	-.12 (.05) *	-.21 (.05) **	.09	.83
	<u>Non-Carcase Meat</u>	<u>All Carcase Meat</u>						
Non-Carcase Meat	-.63 (.09) **	.28 (.11) *	.31 (.05) **	-.01 (.01)	-.01 (.01)	-.00 (.01)	3.49	.87

Figures in brackets are standard errors

** indicates that the coefficient is significantly different from zero at 1% level

* " " " " " " " " " " 5% level

APPENDIX TABLE 3

COMPLETE SET OF REGRESSION COEFFICIENTS FROM "DISAGGREGATED" DEMAND ANALYSES

Dependent Variable	Independent Variables Log of:						Dummy Variables for Quarters of Year			Constant	R ²
	Deflated Price of:					Real Disposable Income	1st Season	2nd Season	3rd Season		
	Lamb & Mutton	Beef & Veal	Poultry	Pork	Non-Carcase Meat						
(6) Lamb and Mutton	-1.43 (.18) **	.28 (.22)	.24 (.09) *	-.54 (.20) *	1.44 (.30) **	.77 (.20) **	.00 (.02)	.06 (.02) **	.10 (.02) **	4.09	.91
(7) Beef and Veal	.38 (.16) *	-1.96 (.19) **	.04 (.07)	.30 (.17) x	-.14 (.26)	.33 (.18) x	.00 (.01)	-.09 (.01) **	-.09 (.02) **	2.30	.95
(8) Poultry	-1.01 (.87)	2.26 (1.06) *	-1.80 (.41) **	3.91 (.96) **	-5.42 (1.45) **	.87 (.97)	-.01 (.08)	.24 (.08) **	.33 (.10) **	.73	.96
(9) Pork	-.27 (.43)	1.63 (.53) **	.42 (.20) *	-1.25 (.48) *	-2.65 (.72) **	.15 (.48)	.04 (.04)	-.12 (.04) **	-.18 (.05) **	-.69	.89
(10) Non-Carcase Meat	.06 (.08)	.34 (.09) **	-.01 (.04)	-.10 (.08)	-.53 (.13) **	.26 (.08) **	-.01 (.01)	-.02 (.01)	-.01 (.01)	3.39	.92

Notes: (1) All variables (except the seasonal dummy variables) are expressed in natural logs and the coefficients are therefore elasticities

(2) Figures in brackets are standard errors

(3) ** indicates that coefficient is significantly different from zero at 1% level

* " " " " " " " " " " 5% level

x " " " " " " " " " " 10% level

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